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Commentary

Two Instruments for Fiber Identification*

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A scanning transmission energy analyzing microscope (STEAM) and an automated microprobe are described and their use explained. In the former instrument the image is scanned across an aperture and quantitative information recorded. In the latter the movement of the beam can be programmed and the x-ray data taken into storage.

This presentation concerns two instruments that we have been working on and with over the last four or five years. Our purpose is to deal with very bulky materials, so that fairly extensive modification may be necessary to convert them for the investigation of fine particles.

Figure 1 depicts the appearance of a chrysotile fiber seen by transmission electron microscopy, showing the progressive degradation that occurs when the fiber is exposed to the electron beam. We need more than morphological appearance before a fiber can be identified as chrysotile. As a metallurgist I like to have an electron diffraction pattern as well. A certain amount of information is necessary as a minimum before identification can be accepted.

The first instrument that I want to discuss is what we call the scanning transmission energy analyzing microscope (STEAM). Figure 2 shows how this differs from the usual scanning transmission electron microscope (STEM). In the latter, the beam is focused to a point on the specimen and is moved by means of scanning coils located above the specimen plane. In our STEAM we

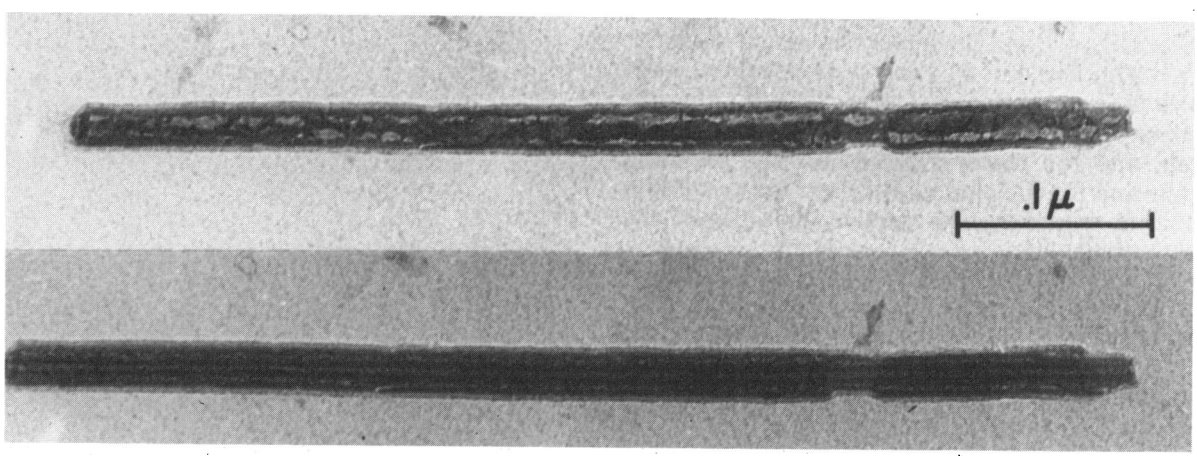

FIGURE 1. Degradation of asbestos fibers by electron beam.

*Editors's extract from transcript of presentation.

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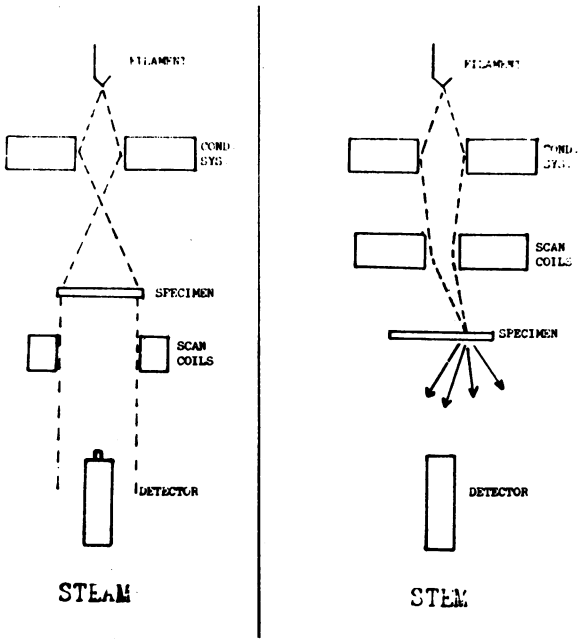

FIGURE 2. Comparison of scanning action in STEM and STEAM.

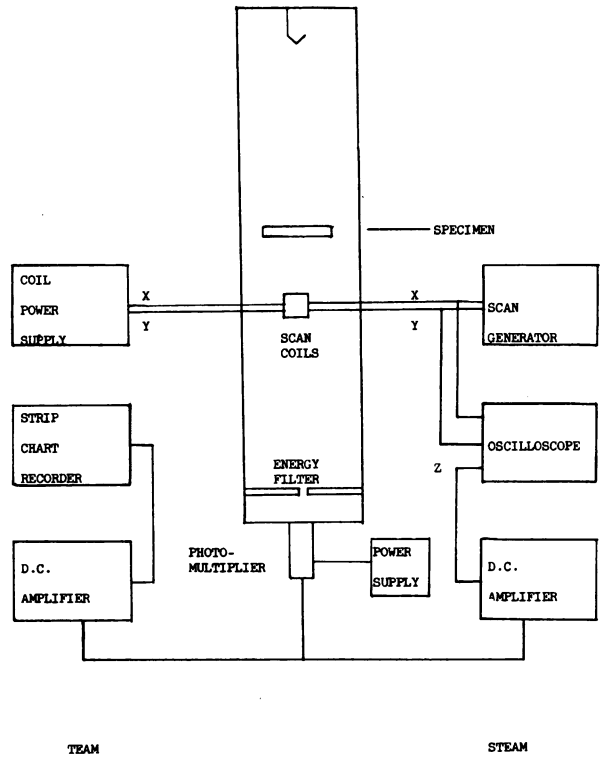

FIGURE 3. Arrangement of units in STEAM.

have placed the scanning coils below the specimen and move the total image across a fine aperture, which we call the energy filter. Figure 3 shows that the image passing through the aperture goes to a photomultiplier detector. The signal from this goes alternatively to an oscilloscope coupled to the scanning coils or to a strip chart recorder. In this way we get quantitative information out of the normal transmission image. Figure 4 shows the actual parts involved. Figure 5 shows the instrument assembly, with a Phillips 200EM, the oscilloscope on the left, the strip chart recorder on top, and the power supplies for the scanning coils and for the photomultiplier. We can obtain images with very low currents because of the photomultiplier.

Figure 6 shows a diffraction pattern obtained on the oscilloscope and Figure 7 the corresponding printout on the strip chart. Identification of patterns can then be made directly on the instrument. The analog signals can be fed into an analog-digital converter, and then to a computer on which one can manipulate the information in any desired fashion. This should have application to biological work.

The second instrument that I wish to discuss is an automated microprobe. Figure 8 shows the

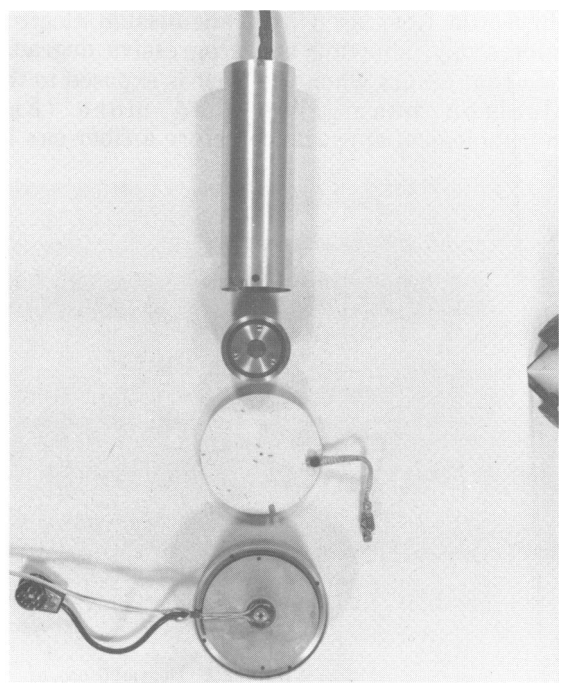

FIGURE 4. Aperture (energy filter) and photomultiplier.

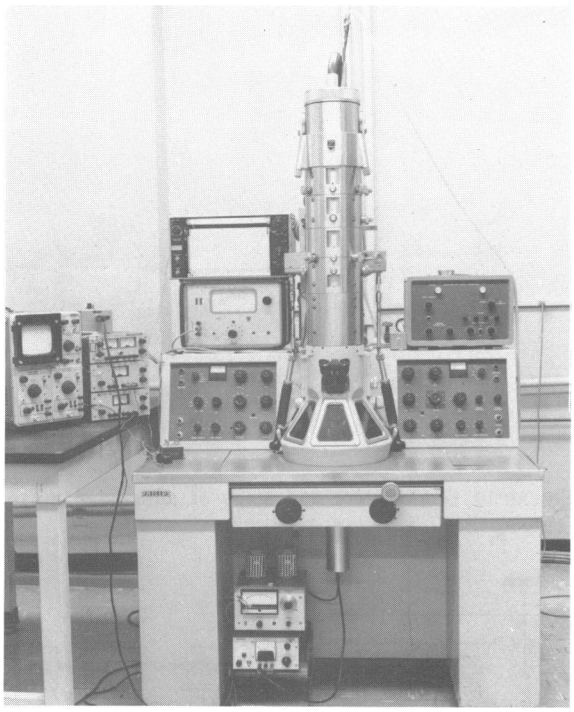

FIGURE 5. STEAM assembly.

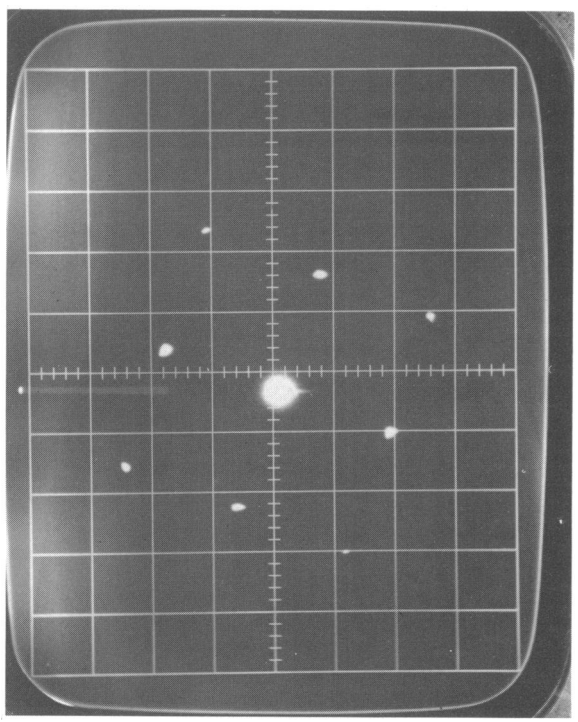

FIGURE 6. Diffraction pattern of test sample.

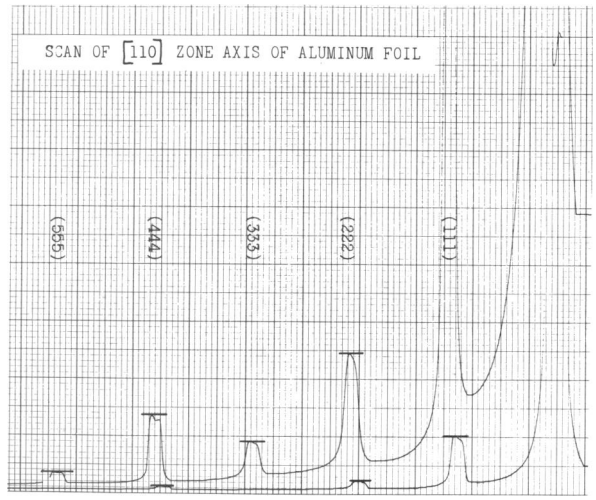

FIGURE 7. Strip chart record from test sample.

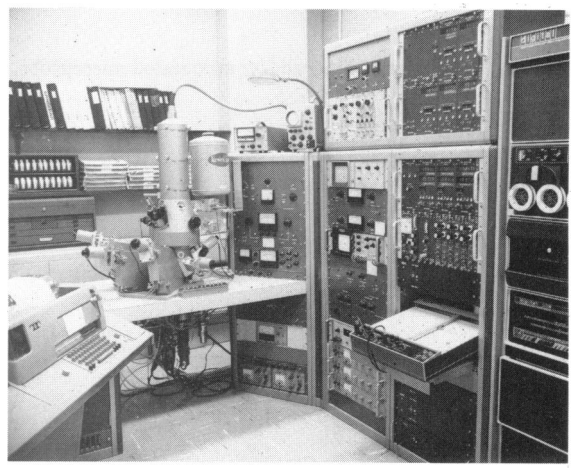

FIGURE 8. Automated microprobe assembly.

assembly with an 11/20 computer that completely controls all of the operations and an energy-dispersive x-ray detector. All of the goniometers, the spectrometers, the $X-Y$ stage and the beam are controlled and can be moved by the computer. The hardware involved is shown in Figure 9. Figure 10 shows the goniometers and the stage, which can be moved in three dimensions. If manual control of the goniometers is required, the switches in the foreground are used to change the mode of operation. All of the information can be taken into memory and re-examined at any time. Figure 11 indicates the arrangement by which

the beam can be moved in the X and Y axes, with set dwell times at every point, and with the x-ray data being taken and stored in the computer.

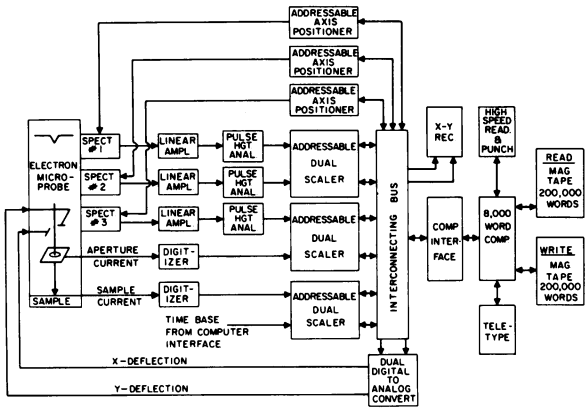

FIGURE 9. Hardware diagram for automated microprobe.

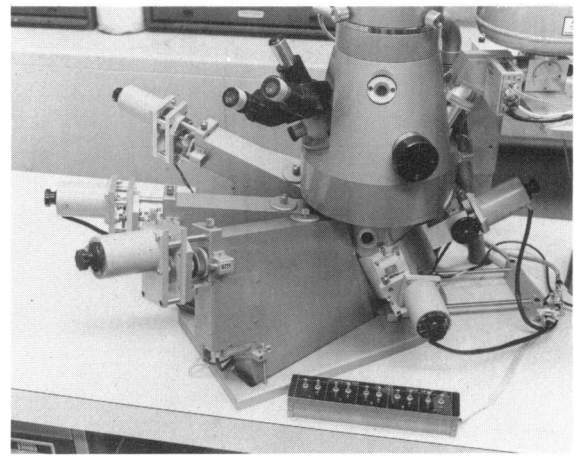

FIGURE 10. Goniometers and stage of automated microprobe.

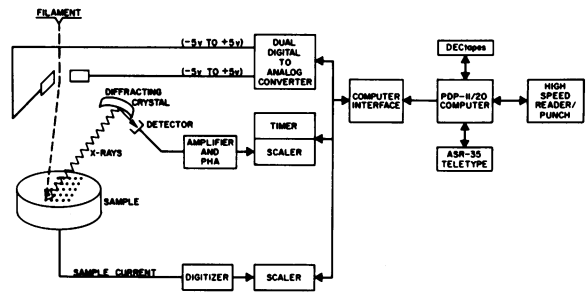

FIGURE 11. Arrangement for beam movement in automated microprobe.